In the claims:

1. (original) An entirely passive all-optical device comprising a stack of a plurality of alternating layers of a first medium and a second medium, each medium characterized by a Kerr coefficient having one of a negative nonlinear coefficient and a positive nonlinear coefficient, each medium further characterized by a linear index of refraction, the Kerr coefficients of the first and second media being of opposite sign and substantially equal magnitude (absolute value), the linear indices of refraction of the first and second media having substantially different magnitudes, the alternating layers arranged such that the medium having the higher linear index of refraction has the negative nonlinear coefficient and the medium having the lower linear index of refraction has the positive nonlinear coefficient.

2. (original) The optical device of claim 1, wherein the optical device provides a first transmittance curve substantially equal to an S-curve and a second transmittance curve substantially equal to an N-curve.

3. (original) An optical hard limiter comprising an entirely passive all-optical device consisting of alternating layers of materials having oppositely signed Kerr coefficients and substantially different linear indices of refraction, wherein the higher linear index material has the negative Kerr coefficient and the lower linear index material has the positive Kerr coefficient.

4. (original) The optical hard limiter of claim 3, wherein transmitted characteristics of the optical hard limiter comprise:

a first range bounded by input signals in the range of approximately zero to I1 in which the transmitted output signal of the stable, non-absorbing optical hard limiter is approximately zero;

a second range bounded by input signals in the range approximately from I1 to I2 in which the transmitted output signal of the stable, non-absorbing optical hard limiter increases from zero to I2; and

a third range bounded by input signals in the range above approximately I2 in which the transmitted output signal of the stable, non-absorbing optical hard limiter is approximately I2, where I1 is approximately half of I2.

5. (currently amended) The optical hard limiter of claim 3, wherein reflected characteristics of the optical hard limiter comprise:

a first range bounded by input signals in the range of approximately zero to I1 in which the reflected output signal of the stable, non-absorbing optical hard limiter approximately equal to the input signal;

a second range bounded by input signals in the range approximately from I1 to I2 in which the reflected output signal of the stable, non-absorbing optical hard limiter decreases from approximately I1 for an input signal of I1 to approximately zero for an input signal of I2; and

a third range bounded by input signals in the range above approximately I2 in which the reflected output signal of the stable, non-absorbing optical hard limiter [[is]] increases as the input signal increases above I2, where I1 is approximately half of I2.

6. (original) An optical logic device for processing information optically using the transmitted and/or reflected characteristics of at least one stable, non-absorbing optical hard limiter.

7. (withdrawn) An optical gain element for converting an optical input signal having an intensity substantially from the set {0,I1} to an optical output signal having an intensity substantially from the set {0,I2}, where I1 is approximately half of I2, the all-optical gain element comprising:

a first stable, non-absorbing optical hard limiter operably coupled to receive as its input a combination of the optical input signal and a signal having an intensity of approximately 4 I1 combined in an approximately 80:20 ratio;

a second stable, non-absorbing optical hard limiter operably coupled to receive as its input a combination of the transmitted output signal from the first stable, non-absorbing optical hard limited and a signal having an intensity of approximately 5 I1 combined in an approximately 80:20 ratio; and

a third stable, non-absorbing optical hard limiter operably coupled to receive as its input a combination of the transmitted output signal from the second stable, non-absorbing optical hard limited and a signal having an intensity of approximately 4.88 I1 combined in an approximately 80:20 ratio and to output its transmitted signal as the output of the optical gain element.

8. (withdrawn) An optical AND gate comprising a stable, non-absorbing optical hard limiter operably coupled to receive as its input a combination of a first input signal and a second input signal combined in an approximately 50:50 ratio and to output its transmitted signal as the output of the optical AND gate, wherein:

the combined input signal is approximately zero and the output of the optical AND gate is approximately zero when both the first input signal and the second input signal are zero;

the combined input signal is approximately I1 and the output of the optical AND gate is approximately zero when the first input signal is zero and the second input signal is I2;

the combined input signal is approximately I1 and the output of the optical AND gate is approximately zero when the first input signal is I2 and the second input signal is zero;

the combined input signal is approximately I2 and the output of the optical AND gate is approximately I2 when the first input signal is I2 and the second input signal is I2; and

I1 is approximately half of I2.

9. (withdrawn) An optical OR gate comprising an optical gain element for converting an optical input signal having an intensity substantially from the set {0,I1} to an optical output signal having an intensity substantially from the set {0,I2, wherein the optical gain element is operably coupled to receive as its input a combination of a first input signal and a second input signal combined in an approximately 50:50 ratio and to output the converted signal as the output of the optical OR gate, and wherein:

the combined input signal is approximately zero and the output of the optical OR gate is approximately zero when both the first input signal and the second input signal are zero;

the combined input signal is approximately I1 and the output of the optical OR gate is approximately I2 when the first input signal is zero and the second input signal is I2;

the combined input signal is approximately I1 and the output of the optical OR gate is approximately I2 when the first input signal is I2 and the second input signal is zero;

the combined input signal is approximately I2 and the output of the optical OR gate is approximately I2 when the first input signal is I2 and the second input signal is I2; and

I1 is approximately half of I2.

10. (withdrawn) An optical XOR gate comprising:

a stable, non-absorbing optical hard limiter operably coupled to receive as its input a combination of a first input signal and a second input signal combined in an approximately 50:50 ratio; and

an optical gain element for converting an optical input signal having an intensity substantially from the set {0,I1} to an optical output signal having an intensity substantially from the set {0,I2}, the optical gain element operably coupled to receive as its input a reflected signal from the stable, non-absorbing optical hard limiter and to output the converted signal as the output of the optical XOR gate, wherein:

the combined input signal is approximately zero, the reflected signal is approximately zero, and the output of the optical XOR gate is approximately zero when both the first input signal and the second input signal are zero;

the combined input signal is approximately I1, the reflected signal is approximately I1, and the output of the optical XOR gate is approximately I2 when the first input signal is zero and the second input signal is I2;

the combined input signal is approximately I1, the reflected signal is approximately I1, and the output of the optical XOR gate is approximately I2 when the first input signal is I2 and the second input signal is zero;

the combined input signal is approximately I2, the reflected signal is approximately zero, and the output of the optical XOR gate is approximately zero when the first input signal is I2 and the second input signal is I2; and

I1 is approximately half of I2.

11. (withdrawn) An optical NOT gate comprising:

a stable, non-absorbing optical hard limiter operably coupled to receive as its input a combination of an input signal and a fixed signal of approximate intensity I2 combined in an approximately 50:50 ratio; and

an optical gain element for converting an optical input signal having an intensity substantially from the set {0,I1} to an optical output signal having an intensity substantially from the set {0,I2}, the optical gain element operably coupled to receive as its input a reflected signal from the stable, non-absorbing optical hard limiter and to output the converted signal as the output of the optical NOT gate, wherein:

the combined input signal is approximately I1, the reflected signal is approximately I1, and the output of the optical NOT gate is approximately I2 when the input signal is zero;

the combined input signal is approximately I2, the reflected signal is approximately zero, and the output of the optical NOT gate is approximately zero when the input signal is I2; and

I1 is approximately half of I2.

12. (withdrawn) An optical NAND gate comprising:

an optical AND gate; and

an optical NOT gate operably coupled to an output of the optical AND gate for logically inverting the output of the optical AND gate, wherein the optical AND gate and the optical NOT gate are based on stable, non-absorbing optical hard limiters.

13. (withdrawn) An optical NOR gate comprising:

an optical OR gate; and

an optical NOT gate operably coupled to an output of the optical OR gate for logically inverting the output of the optical OR gate, wherein the optical OR gate and the optical NOT gate are based on stable, non-absorbing optical hard limiters.

14. (withdrawn) An optical sampler based on stable, non-absorbing optical hard limiters, the optical sampler comprising an optical feedback loop for storing an optical signal.

15. (withdrawn) An optical noise subtractor comprising:

a first optical coupler operably coupled to receive a reference signal B and a control signal of intensity I2 and to output a first combined signal therefrom;

a first optical hard limiter operably coupled to receive the first combined signal from the first optical coupler and to output a reflected signal therefrom;

a second optical coupler operably coupled to receive an information signal A and a bias signal of intensity I2 and to output a second combined signal therefrom;

a third optical coupler operably coupled to receive the reflected signal from the first optical hard limiter and the second combined signal from the second optical coupler and to output a third combined signal therefrom; and

a second optical hard limiter operably coupled to receive the third combined signal from the third optical coupler and to output a transmitted signal therefrom.

16. (withdrawn) An optical automatic gain controller based on stable, non-absorbing optical hard limiters, the optical automatic gain controller comprising automatic gain control logic operably coupled to receive an optical input signal having a first intensity range and output an optical output signal having a second intensity range less than the first intensity range.

17. (withdrawn) An optical switching device based on stable, non-absorbing optical hard limiters, the optical switching device comprising optical switching logic for switching optical information from an optical input to one of a number of optical outputs based upon an address in the optical information.

18. (withdrawn) An optical analog-to-digital converter based on stable, non-absorbing optical hard limiters, the optical analog-to-digital converter comprising a plurality of processing levels numbered one to N, wherein a processing level x (with x=1 to N) includes (x-1) optical limiters biased such that $a=I=^{2x-}1$ and operably coupled in series such that the transmitted signal from one optical limiter is coupled as the input to the subsequent optical limiter, the transmitted signal of the final optical limiter in the series represents the optical output signal for the processing level x, and the reflected signals from the (x-1) optical limiters are coupled together as the input to the processing level (x-1).